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SMOKING FIRES.

THEIR CAUSE AND CURE.



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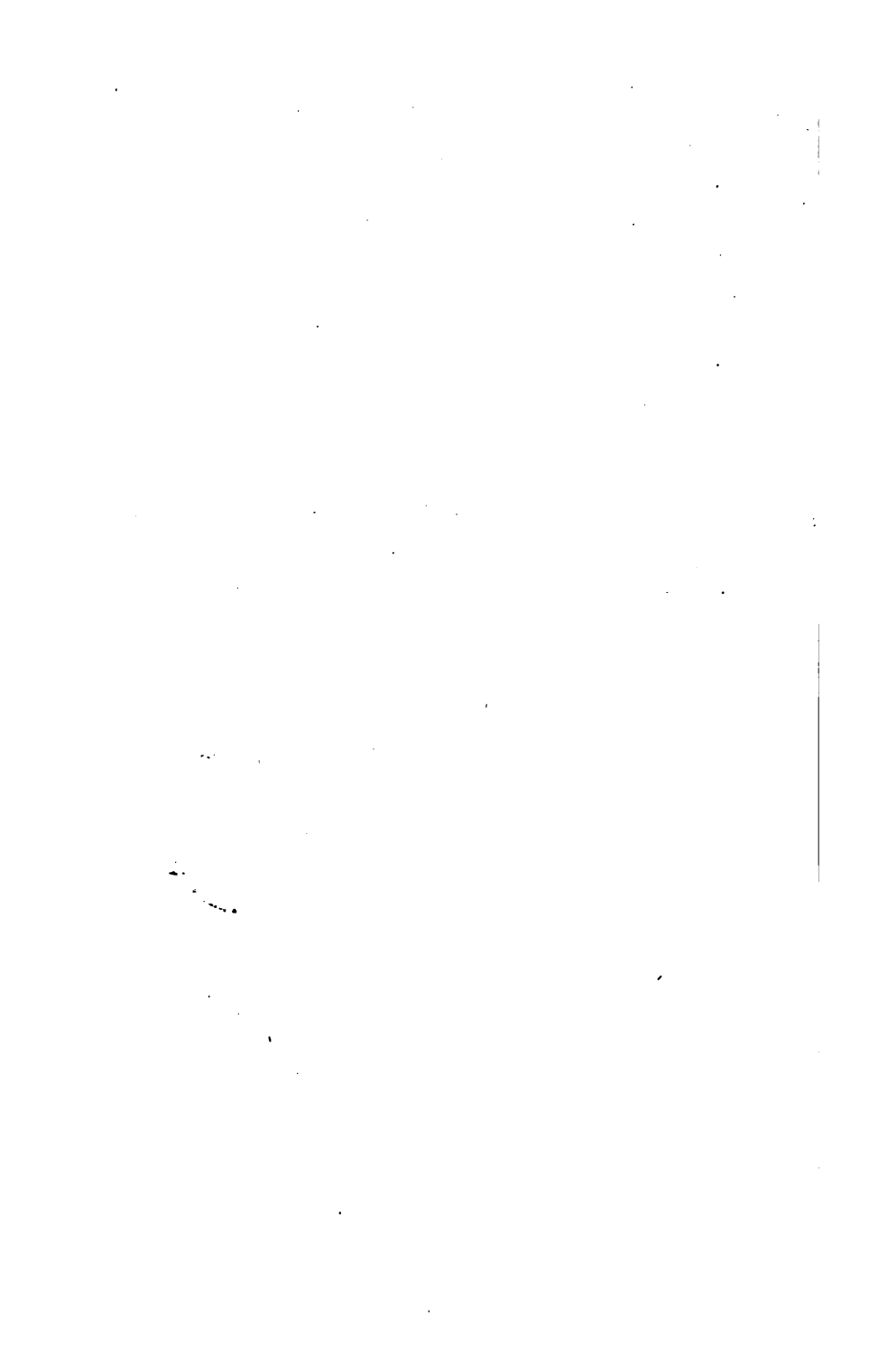
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1871.







SMOKING FIRES

THEIR
CAUSE AND CURE

BY THE
REV. ALEX. COLVIN AINSLIE M.A.
VICAR OF CORFE, SOMERSET

SECOND EDITION



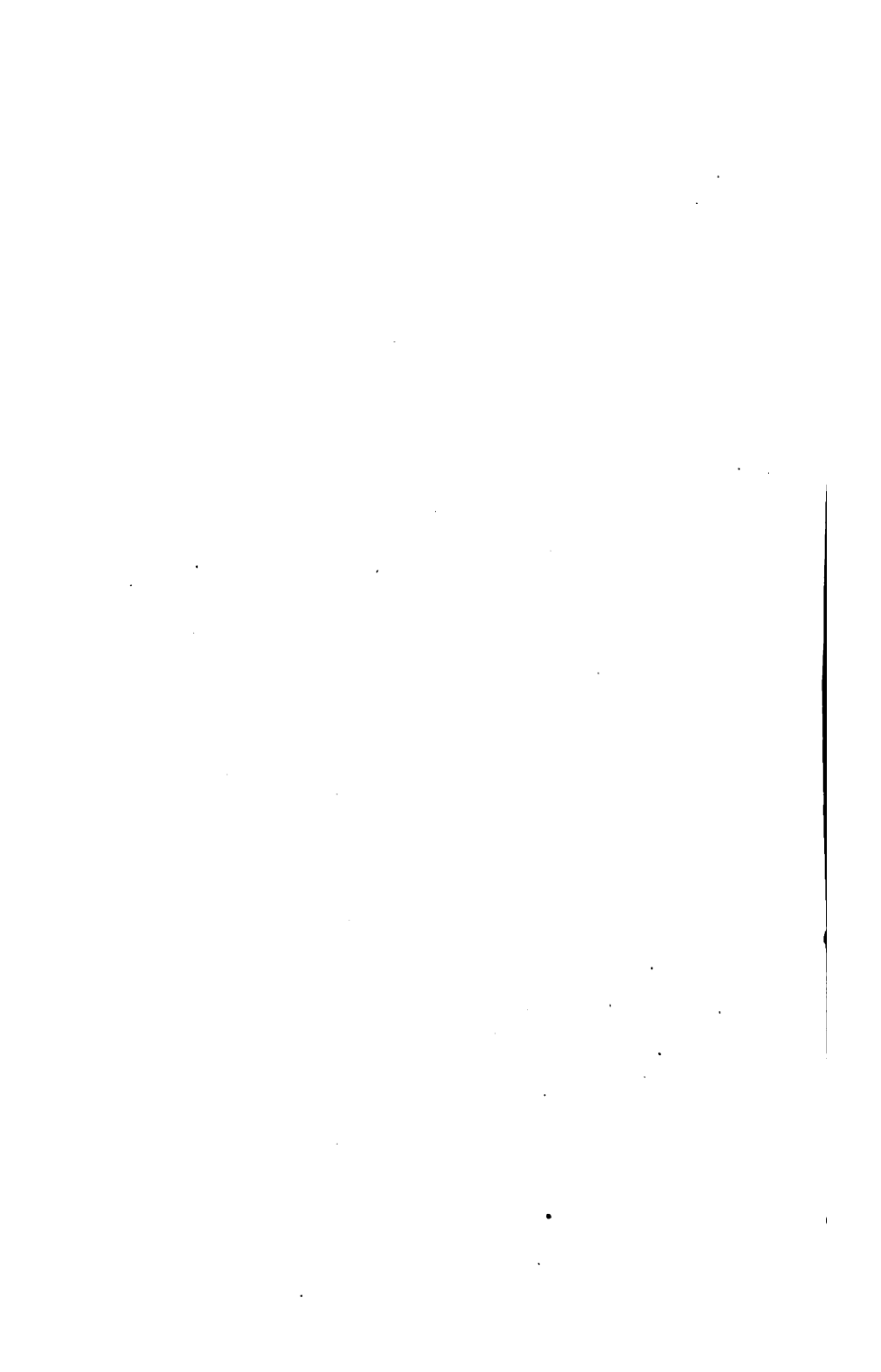
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1871

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PREFACE

TO THE SECOND EDITION.

The favour with which this little book was received by the Press, and the rapid sale of the First Edition in little more than a year, encourages me to put forth a Second Edition, with such alterations and improvements as further experience has suggested. I am happy to think that I have been able to help in some degree to alleviate one of the greatest discomforts of life, and that I have not only suggested means of cure in many cases, but have by the method adopted in the following pages, induced householders to think for themselves, and taught them to discriminate between the causes of smoke. No other method can be considered satisfactory from a

scientific point of view. But it is still so common a thing to see a remedy suggested for smoke arising from one cause applied in a case which has quite a different origin that this little book has obviously not yet done its work, and ventures to reappear once again to take its humble share in the task of scientific instruction.

I have little to add in the way of practical suggestion to what was offered in my First Edition. The expedients there mentioned have borne the test of continued experience, and *when rightly applied* have been successful. I wish however to call attention to the device recommended in Art. 84, of the present Edition, which is theoretically sound in principle and has been found practically useful. It deserves a more extended trial than I, in my limited opportunities, have been able to give it. Unless I much mistake, it indicates the mode which may be adopted with success in the cure of a most numerous and obstinate class of "smokers."

I shall esteem it a favour if my readers will

PREFACE

v

at any time give me information respecting Smoking Fires, and especially respecting cases which have been treated successfully according to the suggestions made in the following pages.

A. C. AINSLIE.

Corfe, Dec. 1870.

FROM THE INTRODUCTION TO THE FIRST EDITION.

The ascent of heated air and smoke is governed by certain known laws ; but when the intolerable nuisance of a smoky chimney occurs, instead of seeking to discover which of those laws has been infringed, instead of listening to what the fire itself would tell us on the subject—and in most cases it speaks eloquently its own wants, and points out to us the illtreatment to which it is subjected—we go to our tinman ; in our misery we are willing to try anything he recommends ; in a day or two a hand truck arrives at our door with a great zinc tube, all knees and elbows, which in due course is elevated to take its place among many similar “ lovely companions.” If success

attends the operation we are content with the result without asking the reason why ; if failure, we go to another doctor and put up, on his recommendation some other equally hideous erection. And so we go on at a great waste of money, temper, furniture, carpets, and curtains.

The ascent of heated air and smoke is governed by certain known laws, and the object of the following pages is to explain those laws as concisely as possible, and to point out the causes which most commonly modify or interfere with their action, and produce results apparently contradicting our scientific theory.

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SMOKING FIRES: THEIR CAUSE AND CURE.

CHAPTER I.

THEORETICAL CONSIDERATIONS.

1. *Atmospheric air is an elastic fluid, and its density at any given temperature is dependent upon the compression to which it is subjected.*

If the air in a vessel whose capacity is one cubic foot, be compressed into the space of half a cubic foot, its density will be doubled.

2. *The elastic force of air varies directly as its density.*

In proportion as it is compressed, in the same proportion does it exert an outward pressure upon the surfaces compressing it.

3. *Air has weight.*

This is capable of proof by actual experiment ; a vessel containing air being weighed, and the same vessel, exhausted of air by means of an air pump, being again weighed, a perceptible difference in weight is discerned.

4. *Air in motion has momentum.*

This follows from its weight. We are sensible of the force of wind, a force varying with the speed with which the air travels, and momentum is represented in mechanics by "weight multiplied by velocity."

5. *The momentum of air in motion exercises a force upon everything opposed to it.*

Hence the action of wind upon the sails of a ship, upon the surface water of the sea. Hence also it will be seen that a current of air in rapid motion striking upon a mass of air at rest, will either set it in motion, if it be free to move, or will exercise a pressure upon it if it be partially confined, which will increase its density and elastic force. The density and pressure of the air on that side of a wall which is turned towards the wind, is greater than that on the side turned from the wind.

6. *The pressure of the air on every point at the earth's surface is due to the weight of the superincumbent atmosphere.*

We may conceive the atmosphere to be made up of a vast number of vertical columns of air, whose base is, say, one square inch, and height equal to that of the atmosphere, whatever that may be. By experiments with the barometer it is found that the weight of every such column

of air is about fifteen pounds. As we rise from the earth's surface, as from the bottom to the top of a house, up a mountain, or in a balloon, we find that the air is lighter, the height of the superincumbent column being less, and that being subjected to less pressure, it is less dense. Therefore the height of a mountain can be determined by the difference of the weight of air at its summit and at its base, as measured by the barometer.

7. *The pressure of air will be the same at all points in any horizontal plane which may be conceived to be drawn through the air at any height above the earth's surface.*

8. *The effect of increase of temperature on air is to decrease its density, and therefore its weight.*

Heat tends to rarify, to separate the particles of air, so that in a given space fewer particles of heated air are contained than of air at a lower temperature. Hence also heated air is lighter than cold air at the same level.

9. From these ascertained facts we can deduce an explanation of the ascent of smoke in an ordinary chimney flue.

Strictly speaking the investigation will be confined to the motion of a current of heated air and gases, the products of combustion; for smoke itself,

consisting of particles of carbon in minute division, though very light, is heavier than atmospheric air, and is carried by the draught of air in the chimney until discharged into the external atmosphere, through which it slowly descends in the dreaded form of "blacks."

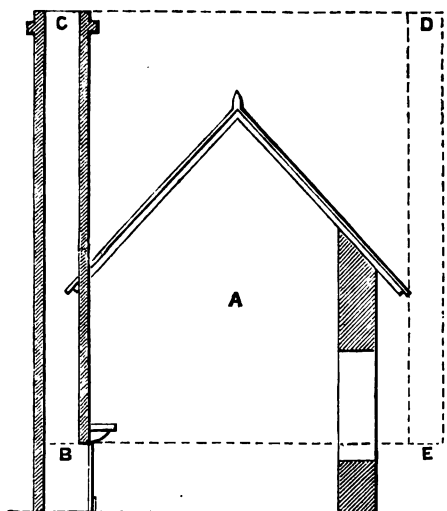


Figure 1.

Fig. 1 represents a section of an ordinary room A, and chimney flue BC. The air in and about the room may be supposed to be made up of an indefinite number of horizontal layers of air, lying one upon another. Let BE represent one such

layer at the height of the opening of the chimney flue ; and, for the sake of simplicity let there be an open window opposite the fireplace, the sill of the window being below the plane BE.

Conceive another horizontal plane, CD, to be taken at the height of the top of the chimney ; then we may disregard all the air above this and confine our attention to that between the planes CD and BE.

First, suppose the air to be at rest both within and outside the room. Then all the pressures acting upon it mutually balance each other, and there is an equal pressure at every point of the horizontal plane BE. Among the pressures to which the plane BE is subjected within the room, one is that due to the weight of the column of air contained in the chimney BC. In order that equilibrium may be maintained there must be on every part of the plane BE, which is equal to the base of the chimney flue, a pressure equal to that due to the air in the chimney. This pressure may be considered as being produced by columns of air of the same height as BC, (6)* and having bases equal to that of the flue. Let DE be one such column ; all else being disregarded these two columns BC and DE may be taken as

* Reference to preceding articles.

balancing one another, as long as the air throughout remains of the same temperature, and therefore of the same density and weight (8).

Now let a fire be lighted at the bottom of the chimney; the air in the flue will become heated and therefore rarified. In its effort to expand itself it will press equally in all directions, downwards as well as upwards; but it will meet with a resistance from the lower stratum of air in the room, greater than that presented to it by the higher stratum at the top of the chimney (6), consequently its expansion will take place upwards and a portion of the air contained in the chimney will be discharged at the top, the remainder continuing to occupy the chimney. But this remainder, being only a part of that which previously balanced the column of air DE, will be unable to balance it; equilibrium will be destroyed; the weight of the column DE will force a portion of the air of the room into the chimney to restore the balance. If the heat be only applied for an instant and then removed, the equilibrium will soon be completely restored; but if the source of heat be one of continuous action, as that of a fire, then the cold air forced into the bottom of the chimney flue becoming itself heated and rarified is continuously driven upwards. Equilibrium is never restored

while the disturbing cause—the fire—is in operation, but the continual excess of the weight of the column DE over the column BC produces a steady upward current in the chimney. For the sake of simplicity, I have supposed the window to be open. The same effect, in kind if not quite in degree, will result if the window be closed, unless it be perfectly air-tight, which in practice is never the case. If, however, the windows and doors be very close, the density of the air in the room will become much reduced, the pressure at the bottom of the flue will not greatly exceed that at the top, the draught will become languid, and very soon the fire will smoke.

10. From what has been said, it will be seen that the conditions which are necessary for the maintenance of a steady draught in an ordinary chimney are these :—

I.—The outlet of the chimney, whatever be its form or its position, must be in a less dense stratum of air than that in which the fire is placed.

II.—The fire must be sufficiently active to keep the temperature of the air in the chimney above that of the external air at the same level.

III.—There must be no impediment to the free ingress of the external air, in order that the density

of the air surrounding the fire may be always greater than that at the top of the chimney.

To these we may add

IV.—The position of the fire with reference to the chimney must be such as not to cause any other current of air which shall diminish the mechanical effect of that in the chimney.

V.—The flue itself must offer no impediment to the ascent of air within it.

VI.—The state of the surrounding atmosphere with respect to its movement under the influence of wind and other causes, must not be such as to introduce a disturbing force of greater power than the forces normally acting.

These are the necessary conditions for the proper ascent of a column of heated air in a chimney ; but as our inquiry has special reference to smoke and other products of combustion, we may add

VII.—The fire-place must be so constructed that the smoke produced shall be caught and retained by the ascending current of hot air.

Given these conditions fulfilled, and there need be no hesitation in asserting that

NO FIRE WILL SMOKE.

CHAPTER II.

CAUSES OF SMOKING CHIMNEYS.

11. The consolatory sentence with which the last chapter ended seems hardly consistent with the heading of this. But if the assertion be true that when the conditions stated are fulfilled no fire will smoke, if we can trace the cause of nearly every case of smoking to the nonfulfilment of some one or more of these conditions, and if moreover we can show that these conditions can, some of them, be certainly satisfied by constructive skill and ingenuity, while none of them are altogether beyond our control, we have ground for expressing at least a confident hope that smoky chimneys are not the irremediable nuisances which they are too often considered. The object of these pages will be in a measure attained if they arouse any suffering householders from the apathy of patient despair into which they may have sunk, and induce them to set to work again in a more scientific spirit, to expend time and money in curing the so-called incurable.

12. We may class the causes of smoking under the heads of the conditions above mentioned, and take note of them as infringements of those conditions severally.

And here it may be observed that cases in which the conditions are *barely* fulfilled, may generally be taken as cases of infringement, because chimneys which, at their best, draw badly, are found to smoke when any, the least, obstacle is opposed to their ordinary action.

13. CONDITION I.—*The outlet of the chimney must be in a less dense stratum of air than that in which the fire is placed.*

In proportion to the difference between the density of these two strata will be the vigour of the draught. Hence the advantage of tall chimneys. As an infringement of this condition may be placed Cause of Smoke I.—Want of sufficient height in the flue.

It is a well known fact that the fire-places of bedrooms are more apt to smoke than those of rooms on the ground floor; and although the outlet of all ordinary chimneys is undoubtedly at a higher level than their fires, yet, for reasons which will be shewn, they are in many cases not sufficiently elevated to be secure against the influence of those atmospheric disturbances which,

tend to raise the density of the air at the chimney top above that of the air at the level of the fireplace. This, a very frequent cause of smoke, may be taken as a case of *bare* fulfilment of a necessary condition. The least disturbing cause is sufficient to derange the normal action of a short flue.

From what has just been said it is evident that many cases of smoke might be attributed to this one constructional fault, which will however be better considered under another head ; for though the shortness of the flue gives the fire a tendency to smoke, it cannot perhaps strictly be said to cause it.

Cause of Smoke II.—The outlet of the chimney being placed in an exposed and cold situation while the air with which the fire is supplied is drawn from a warmer and more sheltered region.

14. The action of this cause may be exemplified by the following case : It was desired to warm a church by means of a stove sunk in the floor of the south porch, with a flue passing along the centre of the principal passage of the nave and terminating in an upright chimney in the angle formed by the north wall of the chancel and the east end of the north aisle. It will be readily seen that the stove was in the warmest and most

sheltered situation, while the chimney was in the coldest and most exposed. The consequence might have been anticipated ; when the wind was in the north or east, *i.e.* in cold weather, no effort could succeed in lighting the stove.

15. **CONDITION II.**—*The fire must be sufficiently active to keep the temperature of the air in the chimney above (practically, very considerably above) that of the external air at the same level.*

To the nonfulfilment of this condition may be attributed a large number of obstinately smoky chimneys with which we are tormented. So we have

Cause of Smoke III.—Excessive width at the bottom of the flue by which a large volume of cold air is drawn in and allowed to lower the temperature of the ascending column.

16. The most incorrigible offender chargeable under this count is the picturesque, time-honoured farm house chimney, with its snug chimney corner, and its smouldering logs upon the brightly polished fire-dogs. It seems treason to speak a word against so venerable an institution, and a Somersetshire man may be taxed with ingratitude for breathing a suspicion as to the soundness of principle of a chimney under which he has pleasantly welcomed Christmas to the hissing music of the west

country "Ashen Fagot." But it is only on great occasions that the fagot blazes high with a heat sufficient to roast an ox, and more than sufficient to give the necessary temperature to the ascending column in the flue. Our ordinary experience of these farm house chimneys is something sadly different—a blinding smoke, blackened ceiling, open door to encourage a draught which the ill-treated fire has not energy to draw for itself. And what better can be expected of a flue built in defiance of all reason? But we will not part from it in wrath, but rather will treat it with the respect which a physician feels towards an interesting patient, whose case is instructive as exhibiting in an unusual degree all the most striking symptoms of a complicated disease. We do not feel sanguine of a cure, but we may hold it up as a timely warning.

17. Scarcely less objectionable in principle are those flues, of which the ordinary kitchen chimney may be taken as a type, in which, to make room for a long kitchen range, a great width is given to the bottom of the flue, whereby a large proportion of the air entering the chimney is not brought into contact with, or proximity to, the heated fuel. The consequence is a lowering of the temperature of the ascending column. This would not of it-

self be sufficient to cause a fire to smoke, if the flue were, (as kitchen chimneys generally are) of sufficient height, but this objectionable formation opens the door, as will be presently shown, to many other causes of disturbance, while at the same time it reduces the power of the draught to withstand the many obstacles presented to it. It may seem that I have a perverse objection to everything that is venerable and convenient, when I add that the old form of parlour and bedroom grate with its serviceable hobs is answerable for much smoke, giving an undue width by which the force of the draught is much diminished, and the temperature of the flue lowered. Who does not know the nursery fire with its kettle on one hob and its saucepan on the other, and its high fender covered with clothes, "airing" (alas! not airing, but suffocating, the fire), and its open door and many consequent draughts? But nurse *will* have her hobs, and if we humbly and timidly suggest a narrow fire, and "trivets," (mindful of college days, and of fires that choked us with dust, but not with smoke), we get a look which sends us down stairs with a mental resolve that we will never again speak a disloyal word against "hobs,"—at least in a nursery.

Cause of Smoke IV.—Low temperature of the interior of the flue, in comparison with that of the external air.

18.—In this we have the explanation of the many cases in which there is great difficulty experienced on first lighting a fire, which will however often burn well after a time. Every housemaid is familiar with these phenomena, and attributes them to their proper cause, but not every housemaid (fortunately, some would say,) can go on to explain, that when the external air is warmer than the air in the chimney, the state of things described in Art. 9, and illustrated in Fig. 1, is reversed. The column BC is heavier than DE, and a downward draught is produced in the chimney. When a fire is lighted at the bottom of such a flue, the heated air caused by it is forced at once into the room, and especially if the door be set open, as is too often done, a current is produced in the wrong direction, down the chimney and out at the open door.

To the cause we are now considering may be referred some of the numerous instances of "back smoke." A cold and unused chimney has its outlet immediately adjoining that of a chimney in operation; the downward draught likely to be generated in the former, carries with it the smoke of the

neighbouring flue, with results too well known to need description. A further and more potent cause of "back smoke" will be explained below.

Cause of Smoke V.—Humidity of the air.

19. It is well known that in clear bright weather when the air is dry, fires burn their best; whereas in damp, and "muggy" weather, they burn languidly, and those addicted to smoking seize the opportunity to do their worst. This may be in a measure attributable to the cause last mentioned, damp weather being often warm, as when a thaw occurs after a frost, and produces a warmth of external atmosphere—a want of density in column DE, Fig. 1—which is unfavourable to vigorous draught. The moisture of the air has also an evil influence in another way. Evaporation has a great effect in lowering temperature, and a fire supplied with air surcharged with moisture, will require a more active combustion to raise that air to a given temperature than if the air were furnished to it dry. And the rapid evaporation that will take place in the ascending column of air in the chimney will tend continually to lower its temperature, to the detriment of the draught. To this cooling by evaporation, combined with other causes, we may attribute the languid motion of the issuing smoke from the chimney top in damp weather, as com-

trasted with its brisk ascent through a clear dry atmosphere.

20. **CONDITION III.**—*There must be no impediment to the free ingress of air at the bottom, in order that the density of the air surrounding the fire may be always greater than that at the top of the chimney.*

A great many cases will come under the head of infringement of this condition. Thus we have

Cause of Smoke VI—Too accurate fitting of the windows and doors, and joints of the flooring

21. The manner in which this cause acts may be easily seen. Conceive a room hermetically closed at all points, the chimney excepted; and a fire to be lighted in the grate; a certain amount of the air will be rarified, and will ascend the flue, until the density of the air in the room is so far reduced as to be equal to that at the top of the chimney; equilibrium will then be restored and all further action will cease. The smoke from the fire, having no tendency to ascend the chimney, will pour freely into the room. It is evident that, while things are in this state, the air in the room is less dense than the external atmosphere at the same level. Now let a small opening be made in the window of the room. A current of air will flow in, its velocity depending upon the excess of pres-

sure of the external air over that of the air in the room. When the latter has been reinforced to such an extent as to enable it to attain a pressure above that of the air at the chimney top, a draught will be set up in the chimney; but this draught, tending in its turn to reduce the density of the air in the room, will continue to encourage the current coming from the external atmosphere through the hole that we have supposed in the window. If we could send through this hole a current of air at any desired velocity, then, however small the hole, we could undertake to keep the density of the room up to a point which would enable the fire to "draw." But, inasmuch as the motion of the air through the hole is solely due to the low density of the air in the room, the raising of that density diminishes the supply of air which fed it. Consequently the case stands thus—if the air in the room be much rarified, the fire will not draw; if it be not much rarified it will not produce a current of the necessary velocity through the hole in the window. Either alternative is fatal. We conclude, then, that inasmuch as the air in the room must be kept of sufficient density to create a draught in the chimney, it must be connected with the external atmosphere by an opening large enough to allow of a supply of air entering at a low velocity; that is,

not requiring for its movement a great difference in the pressures within and without the room.

From this it is evident that to expect a fire to draw without providing for its wants, by a due supply of air, is to demand of it an impossibility. And no less than this is done by those who, living in rooms laid with thick impervious carpets, nail list upon their doors and windows, and close with mat or sand-bag that invaluable entrance for fresh air, the space between the door and floor. Let them do what they will, they may be assured of this, that if hot air is to go up the chimney, cold air must come into the room; if the admission of this air cannot be managed* without causing annoyance and discomfort, that discomfort must be borne, for air the fire *must* have.

The necessity of a due supply of air is a generally recognised condition of the action of a fire, so much so, that "Open the door!" is the first injunction that suggests itself to all minds for the cure of a case of smoke.

But there are cases in which this would be the worst possible advice. These may be considered under the head of

* A method will be explained in a subsequent Chapter by which this can be accomplished.

Cause of Smoke VII—The draught of one fire injuring that of others in the same house

22.—A record of the writer's experience on this point may not be out of place here. Three or four years ago he had occasion to enlarge his house, a part of which was old and ill built with badly fitting outer doors and leaded window casements. The opportunity was taken to replace the latter by well made wooden frames and casements, and new outer doors were provided. It being the month of January when the house was re-occupied, fires were lighted in almost all the rooms, and kept burning vigorously. One evening, the outer doors and windows being closed, a cry of horror was heard to proceed from an old needle woman who was engaged in sewing a carpet in one of the lower rooms, the fire of which had never been known to smoke. The door of the room had been left a little open; and the fire, which had become low, had just been replenished with coal, which, of course, was emitting a volume of black smoke. Suddenly, and with no apparent cause, the smoke poured forth into the room; the draught in the chimney turned downwards and in less than a minute the room was filled with a blinding cloud. In her distress the poor woman had recourse to the invariable remedy; she threw the door wide

open, which had no other effect than that of quickening the downward draught and sending the smoke into the adjoining passage. Her cry brought speedy aid ; as a first step the door was immediately shut, upon which the out-pouring of the smoke instantly ceased, and sulkily and slowly it resumed its ordinary course up the chimney, in doing which it soon received the grateful help of an open window.

This was a highly instructive, though unpleasant, incident ; and suggested a device, to be described below, which should cut at the root of all the causes that produced this sooty catastrophe. It was a case in which the fire that smoked was not to blame, but in which it suffered from the greediness of other more vigorous fires then burning.

It may be thus explained. There was probably not a room in the house in which there was not a fire burning, and the combined draughts of these many fires demanded a supply of air which the chinks and crannies of the well-fitting doors and windows were incapable of supplying. The air throughout the house became, in consequence, greatly rarified. One fire, at this time, being much reduced in temperature owing to recent coaling, was no longer able to maintain its draught, (see art. 15) ; the air in the chimney became more dense than that in

the room; the draught turned, and immediately the other fires throughout the house began to draw their supply down this chimney, the open door of the room allowing a free communication. The closing of the door shut off the detrimental effect of the other fires, and left this to surmount its own difficulties, which it was enabled to do by drawing air, sufficient to maintain a languid draught through the windows of the room.

23. It will happen, not unfrequently, that when fires are lighted in two rooms communicating with each other, one or other will smoke—that, namely, in which the less vigorous fire is burning. If the rooms be closed, and the supply of air be insufficient, the two chimneys draw against each other; the weaker (*i.e.* that in which the column of air is the cooler, and therefore the heavier) yields, and pours its smoke into the room.

24. *A fortiori* if there be a fire in one only of two connected rooms, there will be a downward draught in the chimney of the other, bringing with it any “back smoke” which may be drawn down it, together with sulphurous and sooty odour from the flue itself.

25. And the same effect will be seen in any well closed house where there are fires in some of the rooms, and not in others. If the doors of the

latter rooms are not kept carefully shut, the whole house will be pervaded with a smell of soot brought with cold currents of air down the unused chimneys unless precautions be taken to close the flues.

26. *CONDITION IV.—The position of the fire with reference to the chimney must not be such as to cause any other current of air which shall interfere with the action of that in the chimney.*

Cause of Smoke VIII.—A current, caused by the heat of the fire, circulating in the room.

27. There is a well-known little toy, the action of which depends on the existence of currents of air in a room, which hinder rather than help the ascent of smoke in the chimney. A circular piece of card is taken and a spiral cut is made through it from a point near its centre and continued until it runs out at the circumference. The card being then supported at its centre upon a needle point falls down round the needle in a helical form, resembling a snake. If now it be placed on an ordinary chimney-piece over a good fire it will be seen to revolve, and the direction of its revolution proves the existence of an upward current of warm air, which striking on the under side of the continuous band of card that is presented to it obliquely gives it a motion of rotation.

The current, the existence of which is thus

made evident, has a great influence both for good and evil. The advantage is the aid it lends towards warming the air throughout the room, and preventing the effect of the fire being confined to those parts which are within the influence of direct radiation. The air immediately in front of the fire, being heated, rises to the ceiling, along which it travels ; again descending, after parting with a portion of its warmth, (especially in the neighbourhood of the windows) and passing along the floor it tends to warm the cold air that has come in at the windows, until reaching again the fire, it is either drawn into the chimney, or sent upwards once again to commence another circuit.

It is to be noted that this current is entirely independent of any supply of air from external sources, and would exist equally in a room entirely closed, depending only on the heat of the fire.

It is this fact which gives to this circulating current its detrimental effect in the case of chimneys with languid draughts ; especially if the grate be set far forward. Where this current is of nearly equal velocity with the draught in the chimney, it carries with it some of the smoke, especially that from the front of the fire, and takes it upward of the chimney-piece. Any obstructions, as from gusts of wind, in the chimney, throw more smoke

within the influence of this current, and in fact it is one most fruitful source of annoyance, as to it in a great measure is to be attributed that vexatious oozing and puffing of little curls and jets of smoke from under the upper part of the front of the grate, which make a room, if not uninhabitable, yet exceedingly dirty and uncomfortable. The attempt will be made, in the Chapter on Remedies, to show that this annoyance can be certainly obviated.

28. CONDITION V.—*The flue itself must offer no impediment to the ascent of air within it.*

Cause of Smoke IX—A flue of insufficient size

29. This error may exist throughout the flue or it may be confined to the smallness of the opening at the top, as is frequently the case where a chimney pot is placed at the outlet of the flue.

The objection to a flue of unnecessarily large size has been already considered (art. 16). If the flue be too small or the opening at top too contracted, the free ascent of the column of heated air is impeded, its progress will be unduly slow, the draught at the bottom will be feeble, and unable to resist the injurious action of the many hostile influences which have come under our notice in the successive causes of smoke. (See Causes i, v, vi, vii.)

30. A contraction of the flue immediately above

the fire is not open to the objection here stated. On the contrary from its tendency to exclude cold air, and to cause increased velocity of the ascending current at the point of its greatest heat, it is to be recommended.

Cause of Smoke X—A foul flue

31. In two ways this produces its result. Firstly, by actually diminishing the space through which the air has to pass, and this to a greater extent than is commonly thought.* Secondly, by opposing to the passage of the air the resistance of friction. It is perhaps not generally realized that air is capable of producing friction; but it is an undoubted fact that when a current of air passes through a flue the centre of that current travels with a greater velocity than the outer parts which come in contact with the sides of the flue, however smooth they may be, just as the middle of a river flows more swiftly than the stream adjoining the banks. If the flue be rough on the inside, either from its faulty construction, or from the accumulation of soot, the retarding effect is greatly increased; so much that a clean flue of small dimensions will carry a more rapid current than a larger one,

* If the dimensions of the flue be 9 in. by 14 in., a deposit of soot of one inch in thickness will diminish the area of the flue by one third.

which, although still giving a greater space for the ascent of air, nevertheless retards that ascent, by the roughness or foulness of the interior.

The effect of friction limits the advantage which for other reasons is gained by an increase in the height of a chimney. This, however, will not apply to the case of chimneys in dwelling-houses, unless the areas of the flues be very small. No fear need be entertained of building the chimneys too high.

Cause of Smoke XI—Displacement of masonry or accumulation of mortar within the flue

32. This might have been included under one of the former heads, but it is desirable to call particular attention to it, as a cause of frequent occurrence, too much overlooked.

It may especially be looked for in flues containing many bends and elbows, where we may almost take for granted that the brickwork is badly laid, and where the stem of the sweeping machine is nearly certain to cause a displacement. This displacement is, of itself, a great obstruction, and forms a nucleus round which will gather soot in large quantities, often out of reach of the brush.

33. **CONDITION VI.**—*The state of the surrounding atmosphere with respect to its movement*

under the influence of wind, or other causes, must not be such as to introduce a disturbing force of greater power than the forces normally acting.

Hitherto we have been concerned only with influences of the action of which we have a definite knowledge, and most of which have their position within the house or the flue. We have only had to consider the external atmosphere with respect to its temperature and its density; but we have supposed it to be at rest, and to be of equal density and pressure throughout the whole of any horizontal plane taken at pleasure at any height above the ground.

We have now different and more difficult circumstances to deal with. We have to consider the air as in rapid and unsteady motion, and have to observe the effect of that motion upon its density and upon the current in the chimney. The discussion of this matter may be introduced by stating

Cause of Smoke XII.—The sudden obstruction of the draught by gusts of wind entering the chimney top.

34. This is well known to be a fruitful cause of smoke; one which in many cases renders a room uninhabitable in certain winds.

Our ordinary conception of a wind would describe

it as a vast current of air passing, with greater or less velocity, horizontally over the surface of the earth. This would be but an imperfect description even of a wind in the open sea ; but it would quite mislead if it were applied to a wind as we know it in a town, or in a wooded or hilly country, or indeed in any place in the neighbourhood of houses or where any obstruction is presented to its even passage. The fanciful movements of the dry leaves in autumn ; the strange, and often unaccountable forms and positions taken by the drifted snow, are proofs that the air when in rapid motion, and obstructed in its course, eddies and whirls in all directions ; to the right or left, upwards or downwards. We see the leaves at one moment sucked into the air, at the next dashed almost to the ground, and then swept along by a little whirlwind. Even at a great elevation, in windy weather, we may see the clouds driven into most fantastic shapes, proving the varied intensities and directions of the wind currents. Into such an unquiet atmosphere, the smoke—perhaps with a languid draught—has to make its exit. To understand the difficulties opposed to it, let Fig. 2 be the top of a flue. The ascending current of hot air H acquires a certain momentum, (art. 4) which however is less, for any given speed of ascent, in proportion to the extent to which the air is rarified;

the momentum of this current is less than it would be if it were a current of cold air moving with the same velocity. Now suppose a sudden gust of wind *W*, (that is, of cold air of great density,) to

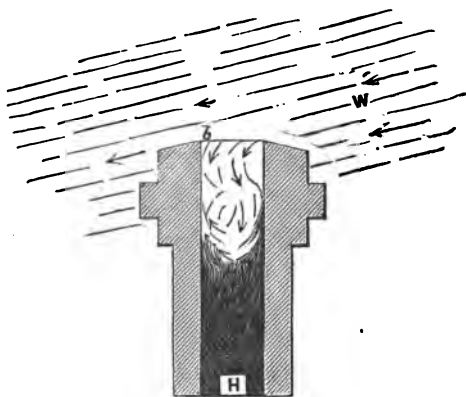


Figure 2

take a somewhat downward direction. A portion of this will strike the interior of the mouth of the flue at the point *b*, and will be reflected downwards, meeting the ascending current of hot air. A struggle now takes place between the two, and unless the chimney has a very active draught, the density and high velocity of the wind will gain the mastery; the current in the chimney is suddenly stopped, and not only stopped, but, air being an elastic fluid, (art. 1) the chimney current rebounds as from a spring cushion, and for the

moment takes a downward course, carrying its smoke back to the fire, and, under the influence of the circulating current described in art. 27, forwards and upwards into the room. The effect is momentary; the eddy of wind which caused it passes, and the smoke resumes its course in the chimney until again interfered with.

Cause of Smoke XIII—Increase of density of the air at the chimney top, due to the effect of wind in chimneys rising from the eaves of the roof

35.—The case of sudden gusts and eddies has been already considered; we have now to do with a steady current of wind.

It frequently happens that chimneys, which commonly draw well, are found to be affected with an incurable downward draught when the wind is strong and from a certain quarter; and this is observed more particularly in chimneys rising from outer walls through the eaves of roofs. Those which go up through the ridge are well-known to be less liable to smoke.

Although the disadvantage of eave chimneys is well known, a mistaken notion is very common as to the circumstances under which they smoke. Their failure is thought to take place when the direction of the wind places them on the *lee* side of the roof, and the cause of failure is assumed to

be certain eddies which curl over the roof, and having a downward direction find their way down the flue. This explanation, however, is set aside by the fact that smoking especially occurs in such chimneys when they are on the *windward*, (not *lee*) side of the roof. Another method of accounting for the fact must be sought.

The following is suggested.

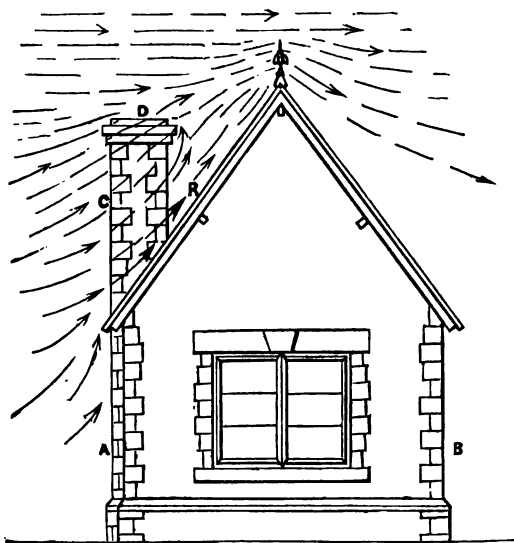


Figure 3

36. Let Fig. 3 represent a house having a chimney C in an external wall. Suppose the wind to be blowing from the side A, on which the chimney

is placed. Now the wall and roof of the house will offer to the wind a fixed obstruction against which it will, by its momentum, exercise a great pressure; which will be absent on the sheltered side of the house. This will increase the density of the whole region of air in which the chimney is situated above that of the air on the sheltered side. The effect of this was explained under Cause of Smoke II. Again we have a further effect of the momentum of the wind. That part of the wind current which strikes the sloping side of the roof is turned upwards, and either bounds back or passes in close contact with the roof. The mass of air immediately behind this is similarly, though less suddenly, deflected from its horizontal course. Thus a continuous current of air of great pressure rises to surmount the roof. But in doing this it ascends to the region of another stratum of air in rapid horizontal motion, and possessing great momentum, and therefore not to be thrown out of its course except by the exercise of considerable force. We thus have two currents of air brought into collision, which cannot occur without their exercising a mutual pressure on one another. Therefore in the region in which these two currents meet, the air will acquire an increased density; and the top of the chimney will be found to be situated in that

region. Hence there will be a constant tendency in the dense stratum of air in which the chimney top is placed, to relieve itself by expansion in every direction—among others, down the flue.

This explanation would place the case of such chimneys among the most difficult to cure; a conclusion which is borne out by experience.

37. **CONDITION VII.**—*The fire-place must be so constructed that the smoke produced may be caught and retained by the ascending current of hot air.*

A common infringement of this obviously necessary condition may be stated as

Cause of Smoke XIV.—**Draughts within the room which throw the smoke out of the influence of the ascending chimney current**

38. This is found frequently to take place in wide open kitchen ranges, when there are several doors to the room, and draughts passing across the fireplace. When the surface of the fire is large, and especially when heaped with fresh coal, such draughts will often seize upon the smoke produced by the fuel lying towards the front, or to one side of the grate, and carrying it out of the upward current which is ascending the chimney, will sweep it into the room from the side of the fire-place. More especially may this annoyance be expected when saucepans, &c., are on the hot plate at the

side of an open fire. This is one of the evils belonging to that radically faulty construction—a wide fire-place, of which a small part only is occupied by the fire.

While it is not pretended that the foregoing enumeration of the Causes of Smoke is exhaustive, it is hoped nevertheless that it will be found to trace to their sources most of the more ordinary cases of annoyance. There will be particular instances which cannot be classed under any general heads, being attributable to special local causes which can only be discerned by close observation. More particularly in houses situated among hills, or trees, or more lofty surrounding buildings, it may be expected that exceptional cases will occur.

CAUSES OF SMOKE

CONSIDERED IN THE PRECEDING CHAPTER.

- I.—Want of sufficient height in the flue.
- II.—The outlet of the chimney being placed in an exposed and cold situation, while the air with which the fire is supplied is drawn from a warmer and more sheltered region.
- III.—Excessive width in the flue, by which a large volume of cold air is drawn in and allowed to lower the temperature of the ascending column.
- IV.—Low temperature of the interior of the flue in comparison with that of the external air.
- V.—Humidity of the air.
- VI.—Too accurate fitting of the windows and doors and joints of the flooring.
- VII.—The draught of one fire injuring that of others in the same house.
- VIII.—A current, caused by the heat of the fire, circulating in the room.

- IX.—A flue of insufficient size.
 - X.—A foul flue.
 - XI.—Displacement of masonry, or accumulation of mortar within the flue.
 - XII.—The sudden obstruction of the draught, by gusts of wind entering the chimney top.
 - XIII.—Increase of density of the air at the chimney top, due to the effect of wind in chimneys rising from the eaves of roofs.
 - XIV.—Draughts within the room which throw the smoke out of the influence of the ascending chimney current.
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CHAPTER III.

SYMPTOMS INDICATING THE CAUSE OF SMOKE.

39. The bare knowledge of the several causes which produce the irregular action of chimneys will be of little avail, unless we can in any particular case determine to which cause the failure is to be attributed ; and this can only be done, firstly, by a careful observation of the symptoms, and secondly by taking into account the circumstances of the case, the position of the fire and chimney, the proximity of other flues, &c.

In this Chapter an endeavour will be made to examine the ordinary phenomena of smoking, and assign them to their proper causes, as a necessary preliminary to the application of the suitable means of cure.

Following the course of a fire's ephemeral life from its ignition to its final extinction, we shall find that at every stage of its existence it is often the victim of ill-treatment, and vindictively revenges its wrongs upon man, carrying on its

vengeance to its last moment, and even when its ashes are cold, haunting the habitation of its tormentor.

40. (A) ON THE ATTEMPT BEING MADE TO LIGHT THE FIRE, THE SMOKE POURS FORTH INTO THE ROOM.

Proof positive of a downward draught, which may be attributed, according to circumstances, to one or more of the Causes numbered II, IV, VII, in page 36. If the annoyance occurs on comparatively calm days when the wind is in a certain quarter, Causes IV and VII may be believed to be acting. If the mischief is increased by opening the door of the room, the window being shut—especially if the outer doors of the house be closed—then it may be concluded that other fires are drawing their supply of air down this chimney. If the chimney has been long unused, Cause IV is to be thought of, more particularly if the external air be warm, as from a thaw.

41. (B) WHEN THE FIRE IS FIRST LIGHTED IT IS NECESSARY TO KEEP OPEN THE DOOR OR WINDOW TO ESTABLISH A DRAUGHT.

In this case the draught is languid, and the windows and doors when closed give insufficient openings for a due supply of air. The weakness

40 SYMPTOMS INDICATING THE CAUSE OF SMOKE.

of the draught may be due to several causes, many of them difficult to remove. The flue may be of insufficient height (I), or of excessive width (II), or of insufficient width (IX), or foul (X), or choked up (XI). Or some of the causes which, when in active exercise, produce a downward draught, may be in partial operation. This case of smoking, though frequently highly inconvenient, as when a fire has to be lighted in a sick person's bedroom, and the open door is objected to, is, on the whole, endurable; and if preventible by an open door, it will be found also to be obviated by a contrivance to be described below.

42. (C) THE FIRE BEING FAIRLY ESTABLISHED, IS NEVERTHELESS FOUND LIABLE TO SMOKE ON THE SLIGHTEST DISTURBANCE.

If a person passes rapidly across the hearthrug, or if the door be quickly closed, a puff of smoke comes into the room. The general weakness of the draught in this chimney, coupled with the circumstance of smoke puffing out when the door is quickly shut, points to want of air as the chief cause of mischief. The windows, doors, and floor are too accurately fitted. Faults may exist in the flue itself, prejudicial to its draught. It may be ill-constructed, and especially it should be noted whether its undue width immediately above the fire

lays it open to the unfavourable action described under the head of Cause of Smoke III.

43. (D) HOWEVER LONG THE FIRE MAY HAVE BEEN LIGHTED, THE CHIMNEY SMOKES, EVEN IN STILL WEATHER, ON THE ADDITION OF FRESH COAL. THERE IS A SLIGHT BUT INCESSANT ESCAPE OF SMOKE INTO THE ROOM, POLLUTING THE AIR AND FALLING IN THE FORM OF SMALL "BLACKS."

This is but an aggravated case of the evil marked (B), and is to be attributed to the same causes, viz. a faulty flue, an undue width of opening, or want of a supply of air. This is probably the most common and most vexatious malady to which our chimneys are subject, rendering our rooms often uninhabitable when circumstances are at all unfavourable to the proper action of the chimney; and it is this which especially supports the trade of the makers of the multiform chimney tops, whose number and variety bear witness to the frequency of the nuisance and the uncertainty prevailing as to its cause and in consequence, as to its cure. We would not willingly believe that it is beyond the reach of a certain cure in all cases; a cure of which a rational explanation can be given. And any other remedy must be considered unsatisfactory; it may serve its immediate purpose, but

42 SYMPTOMS INDICATING THE CAUSE OF SMOKE.

adds nothing to our knowledge, and only perpetuates the unreasoning empiric system which is already in vogue. If in the great majority of cases we can clearly trace the cause or causes which produce a smoky chimney, and can apply the remedy demanded by the individual case, we cannot doubt that very many of the so-called incurable chimneys may be restored to satisfactory operation, and many useless rooms made snug and warm, and withal clean. And, although from our small experience in the *scientific* treatment of fires, we may not hope to be secure against failures, yet, if we can take our domestic chimneys out of the hands of their quack doctors, and subject them to something like rational treatment, we shall take a great step in the right direction.

44. A frequent, but easily overlooked, cause of the escape of smoke in chimneys of languid draught, is the bad fitting of the grate front into the chimney-piece. If the grate is not exactly of the right dimensions the space between it and the stone or marble of the chimney-piece is commonly filled up with cement, which in time cracks and falls out, leaving openings for the escape of smoke. The remedy is obvious, but if it is to be permanent the mason must be instructed to build in pieces of slate or stone with the cement, to hold it well together.

SYMPTOMS INDICATING THE CAUSE OF SMOKE. 45

45. (E) IN WINDY WEATHER THE SMOKE IS FROM TIME TO TIME DRIVEN IN A CLOUD INTO THE ROOM ; OPENING THE DOOR DOES RATHER HARM THAN GOOD.

This was explained under Cause of Smoke XII. It is an intolerable nuisance ; but entirely within our power to remedy.

46. (F) BACK-SMOKE FROM OTHER CHIMNEYS.

This well-known nuisance has been explained above, art. 25. It is, happily, in most cases preventible, but its existence commonly is evidence of a want in one or more of the other fires in the house—a want of sufficient air—and we can hardly be satisfied until we have not only prevented “back smoke,” but removed all tendency to its existence.

47. (G) AS AN AGGRAVATED CASE OF BACK-SMOKE WE HAVE THE TURNING DOWNWARDS OF THE DRAUGHT IN A CHIMNEY THAT IS IN USE, DUE TO THE ROBBING EFFECT OF OTHER FIRES, AS EXPLAINED IN ART. 22.

48. (H) PERSISTENT DOWNWARD DRAUGHT, INCREASED BY OPENING EITHER DOOR OR WINDOW.

This most puzzling case has been traced in art. 36, to causes external to the room, but de-

44 SYMPTOMS INDICATING THE CAUSE OF SMOKE.

pending upon the position of the chimney with respect to the roof, and the direction of the wind. When this annoying form of smoking is observed, the suffering householder will do well to notice where his chimney stands ; whether in an outer wall ; whether rising from the eaves of the roof ; or alongside of (and but little higher than) a neighbouring wall ; whether the nuisance is experienced in rough weather, when the wind blows from that side on which the chimney is placed. Especially, must care be taken to distinguish this case of smoke from those above mentioned (see F and G). The symptoms are in many respects similar ; but while in the former cases the closing of the door and opening of the window removed the annoyance, in this case an open window only serves to increase it, by allowing a free vent to the heavy column of air pressing downwards in the chimney. In a school-room with which the writer is acquainted, in which the fire-place is situated in the western wall, and the chimney rises from the eaves, an open window (on the east side) will produce a downward draught whenever the wind is blowing strongly from the west ; but with windows and doors closed, a fire will burn fairly well. There is here none of the robbing effect of other fires, but the draught is produced by causes

SYMPTOMS INDICATING THE CAUSE OF SMOKE. 45

connected with the position of the chimney relatively to the roof.

Having now made what the doctors call a diagnosis of the various forms in which the malady of smoking shows itself in our domestic chimneys, and searched into the latent causes to which the observed symptoms* are to be attributed we are in a position to go on to consider, in the next chapter, the treatment which reason and experience point out as applicable to the several cases with which we have to deal.

* These are recapitulated on next page.

PHENOMENA OF SMOKE

CONSIDERED IN THE PRECEDING CHAPTER.

- A. On the attempt being made to light the fire the smoke pours forth into the room.
- B. When the fire is first lighted it is necessary to keep open the door or window to establish a draught.
- C. The fire, being fairly established, is nevertheless found to smoke on the slightest disturbance.
- D. However long the fire may have been lighted the chimney smokes, even in still weather, on the addition of fresh coal. There is a slight, but incessant escape of smoke into the room.
- E. In windy weather the smoke is from time to time driven in a cloud into the room. Opening the door does rather harm than good.
- F. Back-smoke in unused flues, from other chimneys.
- G. The turning downwards of the draught in a flue that is in use, due to the robbing effect of other fires.
- H. Persistent downward draught increased by opening either door or window.

CHAPTER IV.

REMEDIES.

49. If the reader's patience has not been exhausted before the end of the last Chapter, he will probably have some little curiosity to know what remedies I have to recommend for the cure of the many acknowledged nuisances which belong to those necessary plagues, fires and chimneys. In this Chapter the attempt will be made to suggest a reasonable remedy for the removal of each one of those Causes of Smoke particularised in Chapter II.

50. At the outset let it be understood that it is absolutely unreasonable and ridiculous to suppose that for unhealthy chimneys, any more than for unhealthy bodies, there can be a panacea, a universal remedy. Many such may claim to exist ; chimneys have their Holloways and Morrisons, quacks who will cure everything (or at any rate charge for the attempt), with some ghastly object in zinc or iron. But if I have rightly distinguished the different causes which produce smoky chimneys, I have at the same time made it evident that there must be corresponding

differences in the means to be adopted to counteract them. It will therefore be the most satisfactory method to be pursued in this Chapter, if we take the order of Causes given in Chapter II, and assign to them severally their proper remedies. It might seem perhaps that it would be more practically useful to put the remedy against the observed symptoms ; but this method would involve much uncertainty, owing to the fact that the same phenomena may arise from very different causes. No general account can be given which will apply with accuracy to any individual case ; each must be judged according to its peculiarities ; the several distinguishing tests must be applied—doors and windows closed and opened, &c.—the surrounding circumstances must be taken into account, until a reasonable assurance is arrived at as to the *cause* of the annoyance, and then the proper method of cure can with confidence be resorted to, and a little trouble and thought will be well repaid by the saving of expense, and the freedom from an intolerable nuisance.

51. Taking in order the Causes of Smoke given in Chapter II, and placing against each its proper remedy, we have

Cause I—Want of sufficient height in the flue.

REMEDY. Build it higher.

This can generally be done, but not always without sacrifice of appearance. The long zinc tube (if of sufficient diameter—not less than ten inches) will often answer the purpose, but it is hopelessly ugly—in a pretty country house absolutely inadmissible. Much may be done with a well shaped chimney top of (so-called) terra cotta, placed upon a base of several courses of brickwork judiciously built upon the top of the existing chimney. As a rule our chimney stacks are much too low, and both appearance and the draught of our fires would be improved by a bolder treatment of chimneys than is usual. A well designed chimney stack is a highly ornamental feature in a country house ; and though expensive, will soon repay its cost in comfort, and in the saving of the endless expense entailed by smoky fires. It is sometimes difficult to give to an existing chimney the increased height necessary, but it is unpardonable to build a new chimney so low as to deprive the fires of the best help which can be given them to overcome the many difficulties that beset them in their efforts to burn well.

52. Cause II—The outlet of the chimney is placed in an exposed and cold situation, while the air with which the fire is supplied is drawn from a warmer and more sheltered region.

REMEDY. Supply the fire with air from the

same side of the house as that on which the chimney stands. A method by which this may in most cases be accomplished will be described below.

The case of the church mentioned in art. 14, was irremediable except by the moving of the stove to another situation, or by the raising of the outlet of the flue, and bringing it up from the ridge of the chancel roof; but no remedy could be depended upon, short of the removal of the stove to some position in which it could be fed by air drawn from the northern side of the church.

52. **Cause III**—Excessive width at the bottom of the flue by which a large volume of cold air is drawn in, and allowed to lower the temperature of the ascending column.

REMEDY. Contract the opening of the fireplace so that it shall be but little wider than the grate—bearing in mind that all air which enters the chimney without passing through or over the fuel is injurious.

53. The old fashioned farm house chimney, already alluded to, presents great difficulties, and if we can only make up our minds to sacrifice the “chimney corner,” we shall do well to build up the great opening and insert a modern grate to the saving of fuel and increase of comfort. If, however, we are not prepared for such a radical

proceeding, we can very likely satisfy, to a certain extent, our conservative instincts, and at the same time make the room habitable, by inserting in the huge fire-place a very open stove with a projecting grate, taking care to close in the whole of the lower part of the chimney round the flue of the stove. In cases where wood is burned, or the stove is considered intolerable, the following contrivance may be expected to fulfil the necessary conditions. It consists of a hollow cone of sheet iron, cut up into an arch at the front, and placed over the fire, leading into the chimney by means of a short metal flue. Great care must be taken if this or the open stove be adopted—and indeed in all cases in which a pipe is carried into a chimney flue—that in building in the pipe no recesses are allowed to remain in which soot can accumulate ; the masonry must be carried in a continuous slope from the pipe to the sides of the chimney, and no part must be out of the way of the sweep's brush. Many a house has been burned down in consequence of neglect of this precaution at the time of altering a chimney ; and unless the mason be carefully watched, he is apt to leave the inside of the chimney in a state the danger of which does not become apparent until revealed by an alarm of fire.

I gladly avail myself of this opportunity to recommend to my readers an excellent and ingenious farmhouse cooking range, invented and patented by T. E. Clarke, Esq. It is designed to burn wood, and has boiler, oven, &c., like an ordinary range. It is constructed by Mr. J. M. Fisher, of Taunton. I mention it in connexion with my present subject, as it has proved an admirable cure for smoke in wide farm-house chimneys.

55. Once more if we may venture to open the nursery door, and say a word or two about a grate with hobs, we would timidly suggest that in cases where the smoking of the fire becomes intolerable, and other methods, to be described below, have been tried in vain (as well they may, for where undue size of opening is the cause of mischief, contraction of the opening is the only certain remedy) there is nothing for it but to sacrifice the width which is so convenient but objectionable, and to diminish the opening till it is little or not at all wider than the grate, and at the same time to decrease the height of the opening as far as it can be done, without taking from the space necessary for kettles, &c. This can be done most simply and effectively by filling up the whole opening of the chimney-piece above the level of the grate, with a plate of sheet iron having an

arch cut out of it of the same width as the fire, and as high as may be necessary,* (see Fig 4). All air entering the chimney will be compelled to pass immediately over the fire, while cold air will be effectually excluded; and if a sufficient supply

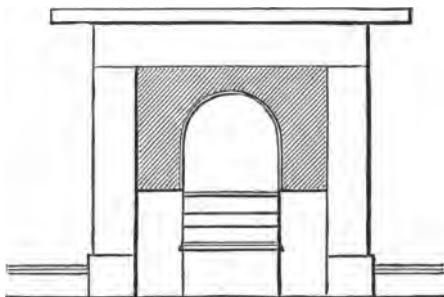


Figure 4

of air be permitted—an indispensable condition in all cases—a fire so treated cannot smoke under ordinary circumstances.

56. Many modern grates with large cast iron fronts fitting on all sides to the chimney-piece, are made with openings of unnecessary size, which may most advantageously be contracted by a method similar to that just mentioned, with this difference, that the plate must be carried down to

* The edge of the plate round the outline of this arch should be stiffened with a bead of half round iron rivetted on.

the hearth stone, (Fig. 5). If the plate be made of good sheet iron and blackened, and the stiffening bead (see note) be polished, such an addition to the fire-place will be found not unsightly ; at any rate it will be far more pleasing in the house-



Figure 5

holder's eyes than the curling wreaths of smoke for which the same grate may have been hitherto notorious. This expedient is inexpensive and experience has proved its utility.

57. It will be seen at once that the action of the ordinary "blower" is on the same principle as that of the iron plate here suggested ; but while the "blower" diminishes the height only of the opening, the arched plate contracts it at the sides also ; consequently it will produce its effect of stimulating the draughts and will yet leave a

sufficient space above the fire to obviate the objection that we are converting an open fire into a stove.

58. **Cause IV**—Low temperature of the interior of the flue in comparison with that of the external air.

This will happen especially when a sudden thaw occurs after a long continued frost.

In art. 18 we have traced to this cause some of the cases in which difficulty is experienced, on first lighting a fire, from a downward draught in the chimney.

REMEDY. This being a temporary derangement, may be sufficiently met by temporary expedients. The following rule may in most cases be found serviceable. *Shut the door and window ; lay the fire with plenty of paper and light wood, and very little or no coal. Crumple up a half sheet of dry newspaper into the form most suitable to make a great blaze when lighted ; set fire to it, and hold it up the chimney ; at first the flame may have a tendency to blow downwards, but this will immediately cease and an upward current be produced ; when this is observed, without delay, set light to the fire with the other hand, and before the sheet of paper is burned out, the blaze from the wood, &c. in the grate, will have taken*

its place, and a draught in the right direction will be continued. If the fire be properly supplied with air (which very few fires are) there should be no further difficulty.

59. When "back-smoke" is the nuisance to be dealt with, and we have no desire to light a fire under the offending chimney, we may resort to the following

REMEDY. Take care that the tops of the flues be as much as possible separated from one another. Architects and builders seem to have a strange notion, that they have done their business when they have designed and built a chimney stack in which the smoke from the different rooms is to issue forth from a number of openings in the flat top of the stack, separated from one another by the thickness of a single brick. Suppose a stack containing six flues to be placed so that the flues lie in a line running north and south, and let the most southern be the kitchen chimney. Several of the other flues are probably unused, the one next to the kitchen flue being very likely amongst the number. There has been a long frost; but now a thaw has come with a warm south wind, blowing the kitchen smoke across the mouths of several of the adjoining flues, in most of which there is, in consequence of the thaw, a strong

tendency to downward draught ! Can any arrangement be conceived more favourable for back-smoke? The flues should be separated as much as possible, and each should terminate in a distinct chimney pot, or other more ornamental top; where possible, *the kitchen and other much used chimneys should be placed at the northern or eastern end of the stack*, in order that their smoke may be blown clear away, at times when the other flues are likely to be most inclined to draw back-smoke.

60. It cannot however be asserted that the division of the tops of the flues will prevent back-smoke in all cases, nor will it have any effect in counteracting that vexatious smell of soot, which comes from within the chimney itself, when afflicted with a downward draught. When the annoyance takes this form we have, in the case of a room in which a fire is not wanted, the very simplest

REMEDY. Close the chimney below, either by shutting down the register, if there be one, or by means of a bag of hay thrust up the chimney, and give a caution to the housemaid not to forget to remove these obstructions before attempting on a future occasion to light the fire. In chimneys situated in external walls, (the worst possible position) it is of importance that their exposed side should be constructed of thick masonry, especially

if the chimney be in a north wall. If this be not attended to, the cold of the air will chill the flue and injure its draught.

61. **Cause V**—Humidity of the air.

The injurious effect of this will be imperceptible in chimneys of lively draught, and the only suggestion which can be offered for counteracting its influence, will be one which is applicable to every case. Do all in your power to encourage a draught ; supply air ; contract the opening of the fire-place, &c., &c. No fire will smoke from this cause alone, and as the medical man prescribes tonics for the improvement of the general vigour of the constitution, so the chimney doctor advises that attention should be given to remove those weakening influences that lay the fire open to be affected with atmospheric changes, which it ought to have strength to treat with supreme contempt.

62. **Cause VI**—An insufficient supply of air to feed the draught, due to a too accurate fitting of the doors and windows and joints of the flooring.

REMEDY. It is vain for us to say, let your windows be illmade, and your house draughty ; let the air come in freely under the door, and sweep in a cold stream over the carpet, making your feet deadly cold, when a north east wind

charged with coming snow is howling round the house. And yet if your fire is to burn brightly, that fire must be freely supplied with air. If you shut it out at the doors and windows you must admit it by some other channel. This is self-evident, yet how many architects and builders will design and construct a house with no provision for enabling a fire to burn! The engineer who plans a boiler furnace makes elaborate provision for a regulated supply of air; the domestic architect alone neglects it. Happily it is not very difficult for us in most cases to supply his omission, and the following device is suggested as one both simple and effective, as experience has proved.

63. Believing that there will always be a sufficient influx of air into an ordinary room to secure a wholesome ventilation, and that anything more than this will be a source of discomfort in cold weather, we may say that the air by which the fire is supplied ought not to pass through the room, but should enter at some point close to the fire, so as to present itself at once to the burning fuel.

64. To secure this in the simplest manner, in an existing building, we have only to recollect that the space between the floor joists, in almost every room with a wooden floor, forms a tube communicating between the neighbourhood of the

hearth-stone and one of the external walls. This tube may be turned to the most useful account. Let an opening by which air can be admitted between the joists be made in the external wall; again let a hole be cut in the floor at the side of the hearth-stone, (see Fig. 6). By these means

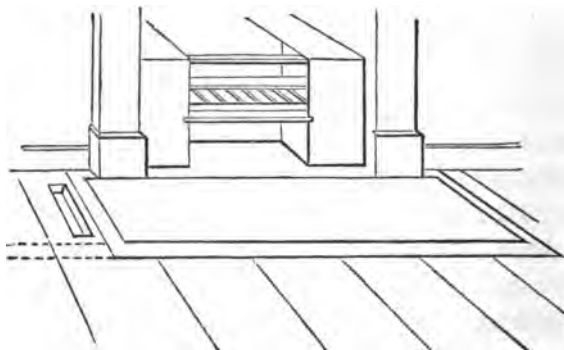


Figure 6

the admission of the external air is secured. It now remains to direct this upon the fire itself, without allowing it to circulate in the room.

65. This may be done by means of a "Ventilating Fender Base," (see Fig. 7), which consists of a shallow tray, one inch in depth, made of sheet iron, of such a size that when placed upon the hearth-stone opposite the centre of the fire-place, one end shall cover the hole in the floor

while the other end projects to an equal distance on the other side of the fire-place. A few inches longer than the fender will in most cases be found sufficient. This shallow tray is constructed with two ends and one side, (see Fig. 7), so that when

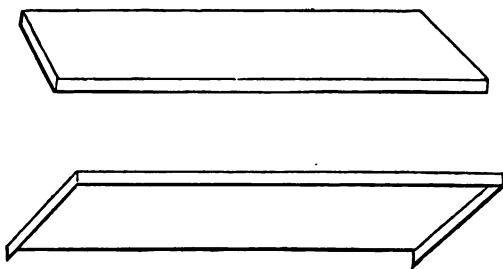


Figure 7

inverted and placed over the hearth-stone and the hole in the floor, the air entering by the hole has free passage towards the grate, but is shut off from the room. Upon this tray, or "Fender Base" the ordinary fender is placed. Its action is obvious. The fire is supplied with an abundant supply of cold fresh air, while the draughts in the room from doors and windows are proportionately diminished. The contrivance is by no means unsightly, the edges of the sheet iron tray being ornamented with suitable scroll work corresponding with the fender, so that when in use the whole

appears as though it were one handsome fender, (see Fig. 8). It has the additional merit of being inexpensive, and while an ordinary mason can readily draw a stone or brick from the outer wall and replace it with a small cast iron grating, anyone can cut the required hole in the floor.*

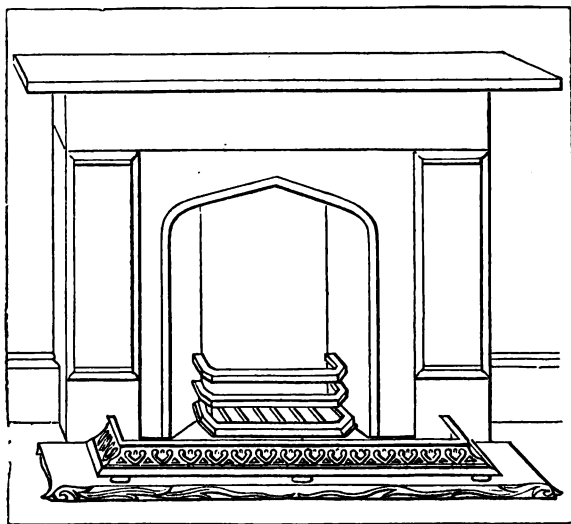


Figure 8

66. No fear need be entertained of the admitted air making the room cold. When the fire is

* It is recommended however that a carpenter be employed as an inexperienced hand may find himself working at the "trimmer joists," which is undesirable.

burning it will consume or carry up the chimney the whole of the air supplied to it, and when the grate is not in use the hole can be closed, if necessary. The effect of this contrivance is most fully seen if the air can be admitted through a north or east wall, as in that case the fire will do its best when it is most wanted ; and, for reasons given in art. 14, the cold air from the shaded side of the house is best suited for supplying an active draught.

67. In illustration of the usefulness of the device here described, may be mentioned two cases; one being that of the writer's own study fire. Its draught was languid, and the use of the poker filled the room with white dust, to the destruction of books, &c. As a first remedy, the opening of the fire-place was contracted, and with advantage;* but it was evident that the fire wanted air, and would never be satisfactory until air were supplied. The contrivance above described then suggested itself, and was tried with complete success ; not only was the draught effectually quickened, but all the dust obviated, the ash that falls from the grate while the fire is burning being driven to the back.

68. The second case is that of a bedroom, in

* Fig. 5, represents the fire-place so contracted.

which the fire never could be lighted unless the door was left open—sometimes for several hours. Admission of air was secured in the way described, and a simple fender base was made, and with the best results. But after some months had elapsed, one evening the house was perceived to be full of smoke which was found to proceed from the afore-said bedroom in which a fire had just been lighted. Had the ventilating contrivance then lost its virtue? By no means. On the contrary its value was to be triumphantly proved. On enquiry it came out that the occupant of the bedroom had, under a mistaken idea that the hole in the floor made the room cold, closed it and replaced the fender base. The housemaid lighted the fire as usual, the door being open when she did so, and left the room, closing the door behind her. Returning in half an hour's time she found the room full of smoke, which, on the door being opened diffused itself throughout the house. It need hardly be said that this unpleasant incident conclusively proved the efficacy of the ventilating contrivance.*

69. When it is considered that of all causes of smoke, want of air is the most common, and that this want can be readily, and at small cost, sup-

* Fender bases as here described are constructed by Mr. J. M. Fisher, Taunton.

plied in the way above mentioned, in the great majority of cases ; is it too much to hope that the suggestions here offered may conduce to the comfort of many, who now suffer from the intolerable nuisance of a smoky fire ?

Apart from the practical inconveniences which too often occur, it may surely be called clumsy and unscientific to depend upon faults of carpenters' work, and shrinking of wood, to admit sufficient air to enable our fires to burn. If architects would become impressed with the idea that it is their business to make independent provision for a supply of air to every fire-place, as much as to make a door to every room, we might confidently hope to see the last of smoky chimneys. In the meantime our only alternative is to take advantage of any device which is calculated to counteract the defects of original misconstruction.

70. Cause VII—The draught of one fire injuring that of others in the same house. An instance of this has been given in page 20.

REMEDY. The general remedy of this evil may be stated thus :—*Let each fire have its own air.* It is unpardonable that the fires burning in a closed house should have no supply of air but such as they can draw down chimneys not in use. But if it be our misfortune, as it is, to live in

houses which are thus imperfectly designed, we must meet the inconveniences as best we may.

71. As a first measure of precaution *shut* the door of a room in which the fire is smoking from this cause ; weigh well the experience mentioned in art. 22. The symptoms which lead us to conclude the presence of this cause of smoking are generally unmistakeable—the steady downward rush of smoke, preceded, it may be, by a sooty smell. A closed door and an opened window are the only immediate resources ; and if we would prevent a recurrence of the nuisance we must take steps to give the offending fire an independent supply of air, by some such means as that described in art. 65.

72. Some persons have resorted to the desperate expedient of bringing air by means of gratings into the entrance hall, or one of the lower passages of a house, in which the fires are afflicted with this disorder. The desired result may thus, doubtless, be in a measure secured, but at the expense of all comfort in the house ; the deadly coldness of the passages and staircase is the penalty paid. Again let it be repeated, *let every fire have its own air*, and this inexcusable cause of smoking will at once vanish.

73. Cause VIII—A current, caused by the heat of the fire, circulating in the room. This

current in itself is both unavoidable and advantageous ; it can only lead to evil in the case of fires of sluggish draught.

REMEDY. Quicken the draught of the fire, by diminishing the opening (art. 53) ; but especially by an increased supply of air. Have the chimney frequently swept. If there is a chimney top, try the effect of removing it.

74. **Cause IX**—A flue of insufficient size.

REMEDY. If it cannot be enlarged, take care that the flue be kept clean. If its length can be conveniently increased let it be done. Above all, give it more air, more especially if an open door serves ordinarily as a cure.

75. **Cause X**—A foul flue, which, as explained in art. 31, is tantamount to a small flue.

REMEDY. Sweep it.

76. **Cause XI**—Displacement of masonry, or accumulation of mortar within the flue.

If this cause be suspected, the special attention of the chimney sweeper must be called to it, and it must be left to him to apply the

REMEDY :—The removal of it.

77. It is worth observing that great care should be taken when any chimney pots, or the like, are being fixed at the top of flues, lest cement or pieces of brick should fall within the chimney. In straight flues they will do no harm,

but in flues with many elbows they are very likely to lodge, and become the nucleus of a mass of soot and rubbish.

We have now to attempt to indicate the remedy for two causes of smoke external to the flue itself.

78. Clause XII—The sudden obstruction of the draught by gusts of wind entering the top of the flue.

REMEDY. It is evident that while the remedy for this must in most cases be applied at the seat of the disorder, anything which will tend to quicken the draught in the flue, will tend in the same degree to diminish the tendency to downward puffs. Especially is a small opening at the bottom of the flue useful for this purpose. The force of the downward tendency being much weakened before it reaches the fire by the elasticity of the column of air in the flue, will be easily overcome by a rapid draught passing through a small opening, and the downward puff will expend itself within the chimney without making its entrance into the room.

It is desirable, however, to take means to meet the evil at its source, and to give such a form and direction to the outlet of the flue as to prevent the sudden gusts of wind from effecting their entrance. For this purpose the ordinary

revolving "cowl" may be employed, the outlet of which is always turned from the wind.

79. A modification of this is constructed by Mr. J. M. Fisher, of Taunton, which has, in addition to the ordinary properties of a "cowl" certain advantages peculiar to itself. The funnel of the locomotive engine, in which the waste steam is utilized to produce a strong draught through the furnace, suggested the idea that the wind, ordinarily the enemy of a smoky chimney, might be made to assist that draught which it was in the habit of impeding. This idea was worked out in the chimney top which has long been widely used in the West of England, under the name of the Luffer Chimney Top. (Fig. 9)



Figure 9

The head revolves upon a central spindle in such a way as always to present the "luffers" to the

wind. These are set at such an angle as to deflect the current of air falling upon them and lead it upwards towards the opening. This blast of air, like the waste steam in a locomotive funnel, tends to produce a strong upward current in the head of the chimney top, and consequently in the flue itself; the higher the wind the better the draught. Several years' experience has proved the success of the contrivance *not as a remedy for every case of smoking*; but as seldom failing in cases to which its application is suitable.

80. To those who adopt it, or indeed any revolving or moveable apparatus, a word of caution must be said—so obvious, that an apology may almost seem necessary, when it is mentioned. It must not only be *put up* in good working order, but must be *kept* in good working order. It has not unfrequently happened that persons who have used this, or other similar contrivances, have at first been delighted with their success, but after several months—at the beginning of the following winter—have found the fire to smoke as badly as ever, if not worse. The reason is obvious, the spindle has become stiff for want of oil, and the chimney top fails to turn its outlet from the wind. It is not uncommon to see on the same house, three or four chimney tops looking one another in the face and remaining immoveable in the teeth of

a fresh breeze. The householder should bear in mind that a contrivance which once acts well, will always act well if it be in good order ; but that no *moveable* device (which is in fact a machine) will continue to do its work unless its free movement be maintained.

81. Occasionally the sweep's brush is responsible for the displacement of revolving chimney cowl. If it be driven violently to the top, it cannot fail to throw the head off the spindle. This must be guarded against, as it easily can be, if the chimney sweeper be favourable to the contrivance ; if not, repeated disasters are likely to occur, until the householder in despair removes what has been to him a source of more annoyance than advantage. Only let him confess that the thing itself was useful while it was in good order, and that its subsequent failure was due to inattention in keeping it clean and the spindle oiled, and to (perhaps wilful) carelessness.

Let the chimney top be thoroughly cleaned out once or twice a year, and no fear need be entertained of its losing its beneficial action.

82. In some cases the contraction of the outlet of the flue by means of a common earthen chimney pot may be found useful to prevent the downward puffs of smoke ; but it must not be

forgotten that as a general rule the contraction of the outlet is detrimental to the draught. A simple illustration will explain this. If I fill a syringe with water it requires a certain definite force applied to the piston to expel that water in a given time : if now I contract the outlet of the syringe it requires a greater force to drive out the water in the same time as before ; or if the same force be still employed a longer time will be necessary to empty the syringe. So with a chimney flue ; the contraction of the outlet is a hindrance to the draught. The force by which the upward current is produced remains unchanged, therefore the velocity of the draught is diminished. It hardly needs explanation that the same objection does not apply to a contraction of the bottom of the flue, which is on all accounts desirable.

83. It will be recollected that a short correspondence took place in the *Times* some time since, with reference to the use of chimney pots. Mr. Mechi, the well-known master of Tiptree Hall, having discovered that a gale of wind had done him a good service by blowing off one or two of his chimney pots, took the hint and removed all the rest on his house, and was the gainer by so doing. We may well believe it ; but we must

not too hastily follow his example, or we may find ourselves sufferers from "back-smoke," and other evils which we had not anticipated. I mitigated the nuisance of back-smoke in a newly built house by the erection of terra cotta chimney pots, but found it necessary immediately to remove that which had been placed upon the kitchen flue, the contraction of the outlet being fatal to its draught.

84. **Cause XIII**—Increase of density of the air at the chimney top, due to the effect of wind in chimneys rising from the eaves of roofs, or in low buildings adjoining those that are higher.

REMEDY. If the explanation given in art 36, be correct, one remedy suggests itself, viz:—Raise the chimney above the disturbing influences which cause it to fail, contracting at the same time, as much as possible, the bottom of the flue immediately above the fire. Although a very considerable elongation of the chimney would most likely be required to raise it entirely out of the compressed stratum of air, the existence of which has been pointed out, yet in practice it may be found sufficient to give a few feet of additional length, the force of the draught in the flue being sufficient to overcome the diminished resistance. Another remedy has suggested itself and has been used with the most beneficial results. The cause

of smoke that we are considering is the excess of density at the top of the flue above that at the fireplace. The remedy just mentioned—the raising of the chimney—tends to diminish the density at the top; can we not also take steps to increase the density at the bottom? Can we not devise some plan by which an increase of pressure above shall at once be counteracted by a simultaneous increase of pressure in the air of the room, or that by which the fire is fed? The following expedient answers the purpose:—make a large wind trunk of wood, or metal, or masonry. Carry it up till its top be close to the top of the chimney—a few inches below so as to be free from smoke. Let it have as large a mouth as possible, not opening directly upwards, but facing in the direction of that wind in which the fire smokes worst, say South West. A sort of funnel or bell mouth is adviseable, the object being to collect as much wind as can be gathered. The lower end of the wind trunk communicates, by means of a passage through the base of the wall and a “fender-base,” (art. 65) with the fire, the passage and fender-base being made amply large. The use of this arrangement will be readily seen. Every violent rush and gust of wind which tends to increase density, and downward

pressure in the hot chimney flue, is certain at the same time to produce downward pressure in the cold wind trunk. This causes increase of density at the fireplace—the air from under the Fender-base actually blows the fire—and at once counteracts the simultaneous downward pressure in the chimney. The outlet of the chimney and the mouth of the wind-trunk being close together, whatever motions or pressures of the air affect the one, injuriously to the fire, simultaneously affect the other, beneficially. To be theoretically perfect the wind-trunk and passages should be as large as the chimney flue, but practically this is not required, but it is strongly recommended that they be made as large as possible. The writer has found this wind-trunk (made experimentally in wood, and still retained) very serviceable in a village school-house, the end of which Fig. 3., may be supposed to represent. It will be seen that the chimney is very badly placed, and as might be expected smoked abominably.

85. **Cause XIV.**—Draughts within the room which throw the smoke out of the influence of the ascending chimney current.

These are either permanent or occasional; some rooms having, owing to the relative positions of doors, windows, and fire-place, a continually circu-

lating draught, while in others such a draught is produced by temporary causes, the opening of doors or windows, or the rapid passage of a person across the fire-place. We need deal only with the former.

REMEDY. By plates of sheet iron presenting their edges to the room, and carried up on one or both sides of the space immediately above that occupied by the fuel, the smoke may be protected from being diverted from its course. If, for example, the offending fire be as is very likely, an ordinary open kitchen range with a hot plate and oven on one side, a plate carried up into the flue from the edge of the hot plate which adjoins the fire, will in most cases effectually prevent the smoke from wandering about the great space of the chimney opening, and will keep it within the influence of the ascending stream of heated air. Experiments may be made with an old tray or sheet of iron held in the hand, or temporarily supported, until the best position has been discovered in which to cut off the circulating draught. The writer can speak from experience of an "inveterate smoker" cured by the simple expedient above recommended.

CHAPTER V.

TO ARCHITECTS AND THOSE ENGAGED IN HOUSE BUILDING.

86. It will not, it is hoped, be thought presumptuous if a few words be said in this Chapter to invite the special attention of professional men to the subject of this little book. The writer would not venture to suppose them ignorant of those theoretical principles which have been mentioned in Chapter I; but as it is an undeniable fact that to this day it is considered a mere "toss up" whether the chimneys in a new house will smoke or not, and no special precautions are commonly taken to ensure their proper action, it cannot be out of place to call attention to those conditions which may not with impunity be neglected. Men who know their business will find little or nothing new in these pages, nothing that they have not successfully carried out in their practice; but it is not always the fate of those that build to fall into the hands

of men who know their business, and a little more knowledge of true principles will often be useful to those whose practice runs in the old groove, who design and build houses as their predecessors did, and trust to good luck for their being comfortably habitable.

1.—Avoid, if possible, chimneys in outer walls, with a northern aspect, if the chimneys rise through the ridge, and with a southern and (more especially) a western aspect, if the chimneys rise through the eaves. In the first case cold is to be feared; in the last the disturbing influence of stormy winds.

2.—Especially avoid chimneys passing up through the eaves of high pitched roofs. If such chimneys must be built, carry them up considerably higher than the ridge of the roof.

3.—Let the masonry of chimneys in external walls be as thick as possible.

4.—Let the flues be large, and of circular section to secure their being thoroughly swept. Unglazed drain pipe one foot in diameter is excellent for the purpose.

5.—Avoid all unnecessary bends and elbows.

6.—Carry up the chimney stacks as high as possible. Make them a principal feature in your design, and take pains with their proportions and

positions, relatively to one another and the general design of the building. The architect is to blame if it becomes afterwards necessary to disfigure his building with zinc tubes and wind-guards.

7.—In chimney stacks containing many flues let their outlets be at different levels.

8.—Let the flue of the kitchen fire be always at the north or east end of a stack, (art. 59).

9.—Take means to supply every fire-place with its own air. This may be done by one general wind trunk to supply all the flues in one stack, or by a separate arrangement for each fire-place. But no house can be considered scientifically built in which this is not provided.

87. To those who are about to build, and who are examining the designs submitted by their architect, let me make this suggestion :—Insist upon being satisfied that proper provision has been made for the due action of every chimney in the house ; see that its course is distinctly traced in the drawings, *that it is supplied with its own air*, that its outlet is in such a position, or at such a height, as to be free from disturbing influences.

88. In selecting grates choose those only, the form and arrangement of which is designed on

sound principles. There are many excellent grates now in the market in which that essential point, a small inlet to the chimney is secured together with a great power of radiating heat. For small bedrooms, a mere front, or simpler still, what are called "Leamington Bars," will be found both cheap and efficient, the sides and back being narrowed and filled in with fire brick.

89. Into the question of kitchen ranges it is not my intention to enter ; many other considerations, besides the prevention of smoke, having to be included in any discussion of their proper form and construction. One point only must be steadily kept in view in the case of open ranges, viz. : that the ingress of cold air to the flue must be as far as possible prevented.

Many open kitchen ranges are advertised and sold which are ingeniously designed for the simultaneous performance of several culinary operations, but the credit of which is occasionally damaged by the fact that they fail in the first point requisite, their fires will not burn without smoking. The fault may be not in the range, but in the manner in which the range is fixed, and in which the chimney flue is carried from the fire. The design of a range should include that of at least the lower eight feet of the chimney flue, and

if this design be departed from in the setting of the range, the inventor should not be held responsible for failure.

90. The theory of heat, of its radiation, reflection, conduction, should be studied by those who would make themselves masters of the whole subject of the action of grates, and who would not only have their fires burn well, but economically—a matter of no small consequence in view of the increasing price of coal. It has been no part of the purpose of this little book to discuss the consumption of fuel ; but rather the attempt has been made to point out those considerations which shall secure that our fires shall burn without filling our rooms with smoke, even though at the same time we entail upon ourselves a quicker consumption of our coal.

It is not denied that a fire-place with a vigorous draught will burn more fuel than the same with a sluggish draught ; but we may venture to appeal to any householder who has suffered—at least, to anyone who is suffering—from a smoky chimney and we believe he will tell us that he would rather pay a coal merchant's bill for twenty tons of coal consumed in bright cleanly fires, which

carry the smoke of that coal briskly up the chimney, than a bill for eighteen tons, a considerable portion of which is distributed in the form of "blacks" over the chintz and damask of his furniture.

SMOKING FIRES

THEIR

CAUSE AND CURE

OPINIONS OF THE PRESS.

Contains many practical suggestions.—*The Builder*.

We can recommend it to the notice of householders, and such as may contemplate building houses.—*The Artizan*.

Mr. Ainslie has aimed at the production of a small and readable manual. He has, undoubtedly, succeeded in his task, and we have no doubt its perusal by sufferers would prove a source of comfort to them.—*The Engineer*.

It is by far the best book upon the subject that we have seen. . . . We advise every one who is troubled with this worst of nuisances to waste no more money over tinmen's abominations, but to invest three shillings in ordering this capital little book.—*Wilts and Gloucestershire Standard*.

To few men has it been given to earn a right to a distinguished position among philanthropists at so small an expenditure of type and paper as Mr. Colvin Ainslie. He has addressed himself to one of the greatest nuisances of civilised life, and dealt with it in such a fashion that his name ought to become a household word throughout the kingdom.—*The Lancet*.

We have to thank Mr. Ainslie for this work. It is by science that art makes progress, and we have here in a small compass what it behoves everyone to know who is engaged in house-building. . . . The plan recommended by Mr. Ainslie appears to be both ingenious and effective. . . . We can cordially recommend this work, the principles it elucidates possessing a wide range of application.—*The Ironmonger*.

That fruitful source of grumbling and frequent irritation, a smoky chimney, has been very copiously dealt with. The author treats the subject in a scientific manner. Especially do we commend the book to architects and builders. Those who are pestered with the nuisance in question should consult this book, in which they will not fail to find a remedy let the cause of their fire smoking be what it may. We venture to affirm that Mr. Ainslie will do more practical good by this little treatise in bettering the tempers of those who are afflicted with smoky chimneys, than if he had written a sermon double the length upon the faults which have their origin in these irritating nuisances.—*Mechanic's Magazine*.

This is a very clever little book, and it should be studied by every one who suffers from the smoke flowing into the room instead of up the chimney. The whole question is examined with much clearness—the rules by which the ventilation of an apartment and its fires are regulated are explained, and the methods by which “the array of hideous contrivances which forms the sky line in almost every London picture,” representing a large amount of human discomfort is superseded, are ingenious, simple, and without doubt effective, because, they are founded on correct principles. In this small book of eighty pages the principles may be learnt, and thus smoke avoided.—*Athenæum*.

BY THE SAME AUTHOR.

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